

CLAIMS

WHAT IS CLAIMED:

- 1 1. A fuel cell maintenance device, comprising:
2 a switch; and
3 a pulse generator capable of pulsing a cathode of at least one cell of a fuel cell stack
4 through the switch when the switch is closed.
- 1 2. The fuel cell maintenance device of claim 1, wherein the switch comprises:
2 a relay capable of shorting the cell of a fuel cell stack; and
3 a dielectrically isolated driver capable of driving the relay.
- 1 3. The fuel cell maintenance device of claim 2, wherein the relay comprises a solid-state
2 relay.
- 1 4. The fuel cell maintenance device of claim 2, wherein the relay is further capable of
2 shorting a second cell of the fuel cell stack.
- 1 5. The fuel cell maintenance device of claim 1, further comprising:
2 a second switch through which the pulse generator is capable of pulsing a cathode of a
3 second cell when the second switch is closed; and
4 a control circuit capable of controlling to which of the first and second relays the
5 pulse generator output is transmitted.
- 1 6. The fuel cell maintenance device of claim 5, wherein the second switch includes:
2 a second relay capable of shorting at least a second cell of a fuel cell stack; and
3 a second dielectrically isolated driver capable of driving a second relay responsive to
4 the pulse generator output.
- 1 7. The fuel cell maintenance device of claim 6, wherein at least one of the first relay and
2 the second relay is further capable of shorting one of a third cell and a fourth cell of the fuel
3 cell stack.
- 1 8. The fuel cell maintenance device of claim 1, wherein at least one of the switch and the
2 pulse generator is capable of receiving power returned from the fuel cell stack.

1 9. The fuel cell maintenance device of claim 8, further comprising a voltage regulator
2 coupled to at least one of the switch and the pulse generator and configured to receive the
3 power returned from the fuel cell stack.

1 10. The fuel cell maintenance device of claim 1, wherein the pulse generator is capable of
2 pulsing a cathode of a second cell when the switch is closed.

1 11. A fuel cell maintenance device, comprising:
2 at least one relay capable of shorting at least one cell of a fuel cell stack;
3 a dielectrically isolated driver capable of driving the relay; and
4 a pulse generator capable of pulsing a cathode of the cell through the relay when the
5 dielectrically isolated driver closes the relay to short the cell.

1 12. The fuel cell maintenance device of claim 11, wherein the relay comprises a solid-
2 state relay.

1 13. The fuel cell maintenance device of claim 11, wherein the relay is further capable of
2 shorting a second cell of the fuel cell stack.

1 14. The fuel cell maintenance device of claim 11, further comprising:
2 a second relay capable of shorting at least a second cell of a fuel cell stack;
3 a second dielectrically isolated driver capable of driving second relay responsive to
4 the pulse generator output; and
5 a control circuit capable of controlling to which of the first and second relays the
6 pulse generator output is transmitted.

1 15. The fuel cell maintenance device of claim 14, wherein at least one of the first relay
2 and the second relay is further capable of shorting one of a third cell and a fourth cell of the
3 fuel cell stack.

1 16. The fuel cell maintenance device of claim 11, wherein at least one of the relay, the
2 dielectrically isolated driver and the pulse generator is capable of receiving power returned
3 from the fuel cell stack.

1 17. The fuel cell maintenance device of claim 16, further comprising a voltage regulator
2 through which at least one of the relay, the dielectrically isolated driver and the pulse
3 generator is capable of receiving power returned from the fuel cell stack.

1 18. The fuel cell maintenance device of claim 11, wherein the pulse generator is capable
2 of pulsing a cathode of a second cell through the relay when the dielectrically isolated driver
3 closes the relay to short the cell.

1 19. A fuel cell maintenance device for a fuel stack including at least one fuel cell, the fuel
2 cell maintenance device comprising:

3 at least one relay electrically connected in parallel across the cell;

4 a dielectrically isolated driver operably associated with the relay to drive the relay;

5 and

6 a pulse generator electrically connected to the dielectrically isolated driver to pulse a

7 cathode of the cell through the relay when the dielectrically isolated driver

8 closes the relay.

1 20. The fuel cell maintenance device of claim 19, wherein the relay comprises a solid-
2 state relay.

1 21. The fuel cell maintenance device of claim 19, wherein the relay is further electrically
2 connected in parallel across a second cell of the fuel cell stack.

1 22. The fuel cell maintenance device of claim 19, further comprising:

2 a second relay electrically connected in parallel across a second cell of a fuel cell
3 stack;

4 a second dielectrically isolated driver capable of driving second relay responsive to
5 the pulse generator output; and

6 a control circuit capable of controlling to which of the first and second relays the
7 pulse generator output is transmitted.

1 23. The fuel cell maintenance device of claim 22, wherein at least one of the first relay
2 and the second relay is further electrically connected in parallel across one of a third cell and
3 a fourth cell of the fuel cell stack.

1 24. The fuel cell maintenance device of claim 19, further comprising a power return from
2 the fuel cell stack to at least one of the pulse generator, the relay and dielectrically isolated
3 driver.

1 25. The fuel cell maintenance device of claim 24, wherein the power return includes a
2 voltage regulator.

1 26. The fuel cell maintenance device of claim 19, wherein:
2 the relay is electrically connected in parallel across a second cell; and
3 the pulse generator is electrically connected to the dielectrically isolated driver to
4 pulse a cathode of the second cell through the relay when the dielectrically
5 isolated driver closes the relay.

1 27. An apparatus, comprising:
2 a fuel stack, including a plurality of cells;
3 a switch bank, including a plurality of switches, each switch electrically connected in
4 parallel across at least one of the cells;
5 a pulse generator capable of pulsing the cathodes of the cells when the respective
6 switch is closed; and
7 a control circuit electrically connected in series between the pulse generator and the
8 switch bank to sequentially open and close the switches.

1 28. The apparatus of claim 27, wherein each switch comprises:
2 a relay capable of shorting at least one cell of a fuel cell stack; and
3 a dielectrically isolated driver capable of driving the relay.

1 29. The apparatus of claim 28, wherein the relay comprises a solid-state relay.

1 30. The apparatus of claim 28, wherein the relay is further capable of shorting a second
2 cell of the fuel cell stack.

1 31. The apparatus of claim 27, wherein each switch is capable of shorting a plurality of
2 cells.

1 32. The apparatus of claim 27, wherein at least one of the switch bank and the pulse
2 generator is capable of receiving power returned from the fuel cell stack.

1 33. The apparatus of claim 32, further comprising a voltage regulator through which at
2 least one of the switch bank and the pulse generator is capable of receiving power returned
3 from the fuel cell stack.

1 34. The apparatus of claim 27, wherein the cells are proton exchange membrane fuel
2 cells.

1 35. The apparatus of claim 27, wherein control circuit includes:
2 a counter driven by a clock; and
3 a multiplexer multiplexing the output of the pulse generator to the switches responsive
4 to the count of the counter.

1 36. A method for transparently maintaining the cells of a fuel cell stack, the method
2 comprising:
3 sequentially pulsing the cathodes of a plurality of cells in a fuel cell stack; and
4 maintaining a consistent number of the cells providing power to a load of the fuel cell
5 stack while sequentially pulsing the cathodes of the cells.

1 37. The method of claim 36, wherein pulsing the cathodes includes:
2 generating a pulse train; and
3 sequentially supplying the pulse train to the cells.

1 38. The method of claim 37, wherein sequentially supplying the pulse train to the cells
2 includes:
3 supplying the pulse train to a first cell of the fuel cell stack to pulse a cathode thereof;
4 and
5 switching the supply of the pulse train from the first cell to a second cell of the fuel
6 stack to pulse a cathode thereof.

1 39. The method of claim 36, wherein sequentially pulsing the cathodes of the cells
2 includes:
3 supplying the pulse train to a first cell of the fuel cell stack to pulse a cathode thereof;
4 and
5 switching the supply of the pulse train from the first cell to a second cell of the fuel
6 stack to pulse a cathode thereof.

1 40. A method for transparently maintaining the cells of a fuel cell stack, the method
2 comprising:

3 generating a pulse train;

4 supplying the pulse train to a first cell of the fuel cell stack to pulse a cathode thereof;

5 and

6 switching the supply of the pulse train from the first cell to a second cell of the fuel
7 stack to pulse a cathode thereof.

1 41. The method of claim 40, wherein supplying the pulse train to the first cell includes
2 counting the pulses in the pulse train and switching the supply includes switching the supply
3 responsive to the count.

1 42. The method of claim 40, wherein:

2 supplying the pulse train to the first cell to pulse the cathode thereof includes

3 supplying the pulse train to a first pair of cells of the fuel cell stack, the first
4 pair including the first cell, to pulse the cathodes thereof; and

5 switching the supply of the pulse train from the first cell to the second cell of the fuel
6 stack to pulse the cathode thereof includes switching the supply of the pulse
7 train from the first pair of cells to a second pair of cells, the second pair of
8 cells including the second cell, to pulse the cathodes thereof.

1 43. A fuel cell maintenance device, comprising:

2 means for imposing a low impedance across at least one cell of a fuel cell stack; and

3 a pulse generator capable of pulsing a cathode of the at least one cell of through the
4 low impedance imposing means.

1 44. The fuel cell maintenance device of claim 43, wherein the low impedance imposing
2 means includes a switch that imposes the low impedance when closed and receiving a pulse
3 from the pulse generator.

1 45. The fuel cell maintenance device of claim 44, wherein the switch comprises:

2 a relay capable of shorting the cell of a fuel cell stack; and

3 a dielectrically isolated driver capable of driving the relay.

1 46. The fuel cell maintenance device of claim 45, wherein the relay comprises a solid-
2 state relay.

1 47. The fuel cell maintenance device of claim 45, wherein the relay is further capable of
2 shorting a second cell of the fuel cell stack.

1 48. The fuel cell maintenance device of claim 43, further comprising:
2 second means for imposing a low impedance across at least a second cell of a fuel cell
3 stack; and
4 a control circuit capable of controlling to which of the first and second low impedance
5 imposing means the pulse generator output is transmitted.

1 49. The fuel cell maintenance device of claim 48, wherein the second low impedance
2 imposing means includes a second switch that imposes the low impedance when closed and
3 receiving a pulse from the pulse generator.

1 50. The fuel cell maintenance device of claim 49, wherein the second switch includes:
2 a second relay capable of shorting at least a second cell of a fuel cell stack; and
3 a second dielectrically isolated driver capable of driving a second relay responsive to
4 the pulse generator output.

1 51. The fuel cell maintenance device of claim 50, wherein at least one of the first relay
2 and the second relay is further capable of shorting one of a third cell and a fourth cell of the
3 fuel cell stack.

1 52. The fuel cell maintenance device of claim 43, wherein at least one of the low
2 impedance imposing means and the pulse generator is capable of receiving power returned
3 from the fuel cell stack.

1 53. The fuel cell maintenance device of claim 52, further comprising a voltage regulator
2 coupled to at least one of the switch and the pulse generator and configured to receive the
3 power returned from the fuel cell stack.

1 54. The fuel cell maintenance device of claim 43, wherein the pulse generator is capable
2 of pulsing a cathode of a second cell through the low impedance imposing means.